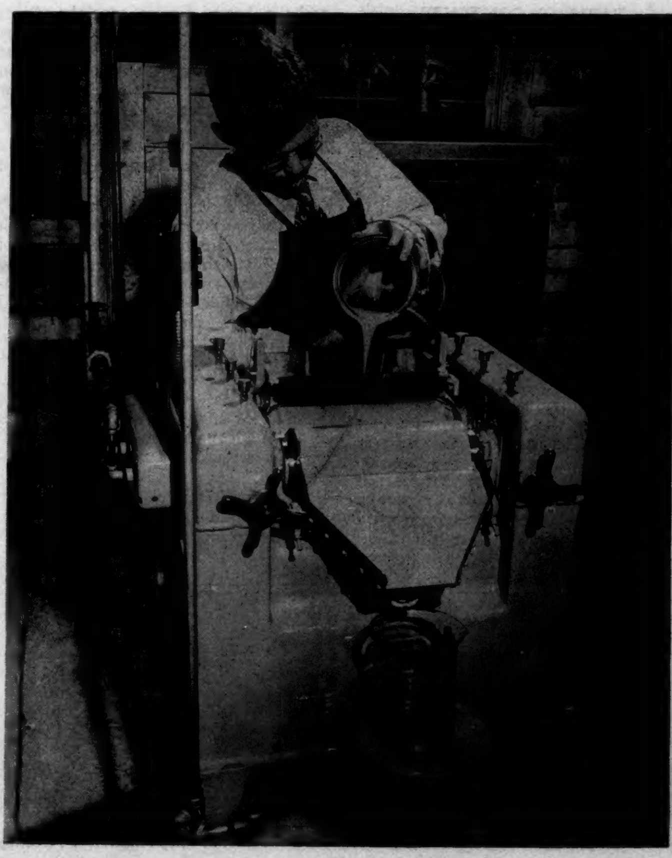
STATE ENGINEERING EXPERIMENT STATION

The Research Engineer

GEORGIA INSTITUTE OF TECHNOLOGY

NOVEMBER ATLANTA, GEORGIA 1950



The Research Engineer

Published in May, September, November, January, and March by the State Engineering Experiment Station of the Georgia Institute of Technology, Atlanta, Georgia. 1950-1951 Volume, Number 3. Entered as second-class matter September 20, 1948, at the post office at Atlanta, Georgia, under the Act of August 24, 1912. Acceptance for mailing at the special rate of potsage provided for in the Act of February 28, 1925, Section 538, P.L.&R., authorized October 18, 1948.

GERALD A. ROSSELOT, *Director* FRED W. COX, JR., *Assistant Director*

B. H. WEIL, *Editor*

PAUL WEBER, *Associate Editor*

MAE R. DAUGHERTY, *Assistant* MARJORIE BOLEN, *Assistant*

TABLE OF CONTENTS

RESEARCH FACILITIES

The conduct of research investigations, fortunately or unfortunately, is no longer chiefly a matter for ragged geniuses laboring skillfully in lofts and barns, without adequate equipment, to develop devices and methods such as those from which our present civilization has grown. Much is still accomplished by individuals who work alone, it is true, but the complexity of science and engineering is now such that even these individuals must usually have access to complicated equipment if their studies are to be carried to completion.

Moreover, when it comes to the conduct of industrial research, and applied research for Government agencies and the Armed Forces, even the efforts of skilled individuals must often be combined, in "teams" whose joint work then makes possible the solution of problems that may be beyond the ability or training of an individual. To accomplish their goals, these teams require a minimum—and not too low a minimum—of complex equipment and adequate laboratories.

Private industry has come to realize that the research laboratories which it has created are not mystical "halls of science" which need equipment merely for ornamentation, and that these laboratories render services which are far greater than mere advertising value. Naturally, common sense economics always dictates the size and scope of each research laboratory, but the day is passing when an organization can hire a scientist or engineer, equip a room for him, and expect him to perform numerous miracles in a short period of time.

The need for well organized laboratories to conduct research for those un-

Continued on Page 24

In these days of the glorification of research, in engineering institutions and elsewhere, it would be all too easy to forget that education is the foundation upon which research must be built. Were it not for our scientific and engineering schools and colleges, the research scientist could not obtain the broad background so necessary for his efforts. Obviously, then, attention must continue to be focused upon education as such, in addition to research as such.

Engineering schools in particular place much stress, today, upon the conduct of research by members of their faculties. This is an important and significant trend, since joint research and teaching catalyze efforts in both fields. However, for the benefit of future research scientists, as well as those who will work in industry, it is always important that the teacher-researcher remember that his is a dual role and that emphasis must be impartially divided. When this is considered, the importance of joint education and research programs at engineering institutions can never be over-emphasized.

BLAKE R. VAN LEER,

President, Georgia Institute of Technology

COATINGS RESEARCH AT GEORGIA TECH

By W. R. TOOKE, JR.*

Coatings for materials of fabrication and construction, fabrics, paper, and numerous other substances have long been of great importance. Georgia Tech has been engaged in research in this field for over ten years; the following article presents a description of some of this work and of the specialized laboratory recently expanded for research on coatings.

Through the ages, man has waged a continuous battle to preserve the products of his handiwork from the forces of nature. While the concentrated violence of storms and floods causes destruction in limited areas, the larger battle is against nature's slow but unrelenting attacks, which in the end cause the greatest general loss. The cost of such erosion is truly astronomical; in the United States alone, losses from deterioration and corrosion amount to many millions of dollars yearly.

**Research Assistant.*

Nature has a most formidable group of weapons. The sun's radiation, oxidation and moisture from the atmosphere, ice and snow, insects, and microorganisms are but a few of the many weapons at its disposal. Moreover, two of man's most useful materials, steel and wood, are particularly subject to corrosion and deterioration.

PROTECTIVE COATINGS

Protective coatings have been, and even today are, the most generally useful armament available to man for protection against the attacks of nature. The use of coatings

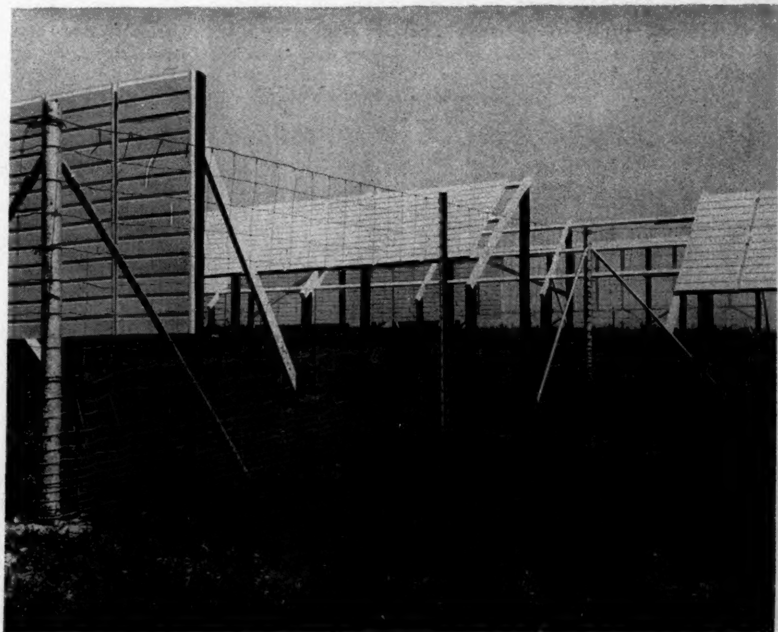


Figure 1. Vertical south (left foreground) and 45° south (center and right) test fences in the Georgia Tech Engineering Experiment Station's paint exposure station.

dates back to prehistoric days, for the early Egyptians are known to have used pigmented linseed oil paints, since residues of this material have been found in their oldest tombs. The first coatings were presumably used only for artistic and decorative purposes, but the enhanced durability of coated articles was soon discovered, and coatings then began to assume both decorative and protective roles.

Only within the past 30 to 40 years, however, has the science of chemistry been extensively employed by coatings manufacturers. In the paint industry, for example, secrets of varnish and paint making were formerly guarded jealously and handed down from generation to generation. Recipes were followed without regard to the *whys* and *hows* of the process. Since the turn of the century, however, the application of sound scientific principles to this industry by modern chemists and chemical engineers has resulted in tremendous gains in economy and quality of products. The old varnish maker, who cooked his varnishes by rule-of-thumb and his senses of sight, smell, and touch, has now been largely replaced by modern instruments which automatically maintain process variables within predetermined limits. In addition, control laboratories are constant guardians of product uniformity and quality in the manufacturing plants of today.

While coatings for wood and metal objects are an "old story," those for fabrics and paper are a comparatively recent development. Oil was perhaps the first substance used to coat these materials, its purpose being to impart water resistance. The well known oilskins, traditionally used by seamen, were first made in Scotland several hundred years ago by a process which consisted of impregnating a textile material with linseed oil and allowing it to dry in the sun. This fabric was sticky and unattractive, but it served its purpose for many years.

RUBBER AND PLASTICS

The discovery and use of rubber effected great improvement in coated fabrics. Rubber combines excellent water resistance with good low-temperature flexibility, a quality which oiled fabrics lack. Even today, the superiority of natural and synthetic elastomers is unchallenged for many coatings uses.

About 1915, nitrocellulose or pyroxylin coatings came into use. These coatings, since they could be brightly pigmented, became very popular, but, as in the case of the oilskins, poor low-temperature flexibility limited their usage for many purposes, and rubber remained the coating material used in the largest quantities.

In recent years, vinyl resins have assumed a dominant position in the fabric coating field. During the recent war, polyvinyl chloride was used for the majority of the coated fabrics produced for military and civilian uses. These fabrics are tough, flexible, light-weight, and flame resistant. They did such a good job during the war that their usage since has continued to grow, and today polyvinyl chloride and vinyl chloride copolymers are the fabric coating materials used in the greatest quantity.

While only a few types of coatings have heretofore been mentioned, the scope of the coatings field is actually extremely broad. Coatings are applied to wood, metal, ceramic materials, textiles, paper, leather, and many other materials. Types of coatings include paints, enamels, varnishes, lacquers, special plastics, waxes, sizes, inks, metallics, ceramics, and others. Countless formulations and application techniques have been developed for each of these types of coatings, but industry continues to seek increased economy, improved beauty, and greater durability from its products.

GEORGIA TECH RESEARCH

Coatings studies are by no means a new field of research for the Georgia Tech Engineering Experiment Station. Ten years ago, in September, 1940, a program entitled "Physical Studies of Primers in Two-Coat Paint Systems Applied to Southern Yellow Pine" was undertaken under the direction of Dr. Paul Weber. The achievement of satisfactory paint durability on southern yellow pine has long been a problem of importance in the South to the lumber and construction industries as well as to paint manufacturers. The investi-

Continued on Page 19

THE GEORGIA TECH LIBRARY AS A TOOL FOR SCIENCE AND INDUSTRY

By B. H. WEIL* *and* DOROTHY M. CROSLAND**

The scope, facilities, and problems of the Georgia Tech Library are already generally familiar to readers of THE RESEARCH ENGINEER through its "Report from the Library" series, but it has nevertheless seemed more than fitting to publish here an over-all account of its present status. The following article was presented in San Francisco in 1949, before the Division of Chemical Literature of the American Chemical Society, as part of a symposium on "The University Library as an Aid to Scientific Work." While its emphasis is on the Library's chemical and chemical engineering collections, its picture is representative and indicative.

The university library, especially in a technological institution, may be likened to a multiple-edged tool, one of whose cutting edges—that for education—must of necessity be kept continually sharpened, but whose other edges must be carefully honed if they are to be used effectively. At Georgia Tech, the Institute's library has not lost sight of the forest because of the trees; however, while its main efforts have been devoted to servicing the education of engi-

*Head, Technical Information Division, Georgia Tech Engineering Experiment Station.

**Librarian, Georgia Institute of Technology.

neering students, it has also devoted an appreciable part of its endeavors to the development of a collection of value to science, engineering, and industry in other than instructional work; that is, in graduate research, departmental research, engineering experimental station research, and industrial operations.

In addition, the Georgia Tech Library has cooperated wholeheartedly in the development of the literature research program of the Technical Information Division of the Georgia Tech Engineering Experiment Station, which group has made available to any sponsor the preparation of literature searches, informational surveys, current information summaries, and other bibliographic services.

LIBRARY ORGANIZATION

The Georgia Tech Library itself is housed, at present, in a small, two-story structure and in the basement of an adjoining building—space sadly inadequate for the purpose. Steps to remedy this handicap, however, have long been planned and at last seem imminent.

At present, the library's scientific and engineering collection totals 112,000 volumes, including transactions and proceedings of scientific and engineering societies throughout the world. The library currently receives approximately 2,419 journals (about one half of which are foreign), United States patents, British abridged patent specifications, the Oak Ridge reports on atomic energy, and the FIAT Review of German Science, 1939-1946. This last file is one of only 250 in libraries throughout the world. The library is also a depository for the Radiation Laboratory reports, the Army Map Service, the Air Materiel Command Air Documents Index of Captured German Scientific Documents, the Atomic Energy Commission's declassified and unclassified research reports, and many reports of the Office of Scientific Research and Development.

To make this collection readily available under the handicap of inadequate space poses problems which the library has had to deal with in various ways. The shelves of the main library house most of the books and journals needed for instructional purposes, plus all reference works, journals, and indexes for which there is constant demand. The library's growing patent and map collections, however, are temporarily housed in another building, as are the U. S. Government publications, the OSRD reports, Radiation Laboratory reports, and the Oak Ridge reports.

In addition to the main Georgia Tech Library collections, the library maintains a number of departmental libraries in certain of the engineering schools, and also supervises working collections in those schools and departments where full-scale departmental libraries are not warranted. These libraries and working collections are intended to provide their respective users with those books and journals which are specifically and closely related to their fields of study and research; in the case of the departmental libraries, their collections do not always duplicate that of the main library but, instead, contain most of the library's accessions in these fields.

To service all of its collections, the Georgia Tech Library has a staff of 13 persons with degrees in library science and 9 clerical assistants. This number is by no means adequate for the present program, much less that which is contemplated, but it is literally all that the present buildings can usefully house.

LIBRARY PROGRAM

In addition to the books and journals required for use in the education of engineers and scientists at Georgia Tech, the library has long been endeavoring to create a collection which will serve as background for a strong program of graduate and industrial research. This has called for emphasis on the literature not only of the various engineering fields, but also of the pure sciences—chemistry, physics, mathematics, etc.

In the fields of chemistry and chemical engineering, for example, considerable attention has been focused on the acquisition of indexes to the periodical literature, such as *Chemical Abstracts* (1907-), *British Abstracts* (1924-), *Chemisches Zentralblatt* (1830-), *Engineering Index*

Continued on Page 16

HYDRAULIC WEIGHING SCALE

By R. A. HALL*

The recently developed lightweight hydraulic scale built at the Georgia Tech Engineering Experiment Station in collaboration with the Georgia Agricultural Experiment Station fills a long-felt need of the beef-cattle-raising industry for a portable yet rugged device which will permit rapid, accurate weighing of livestock directly in the field.

In science, industry, and agriculture alike, the need often occurs for quantitative evaluation of an object, sometimes expressed simply by its weight. Cattle raisers, for example, have no other real basis on which the price of cattle for market sale can depend. Obviously, they have need of equipment—scales—with which to obtain the needed measurements—weights—quickly and accurately, preferably in the field. Just as obviously, such equipment must be truly portable and durable.

Until recently, none of the scales available to cattle raisers completely satisfied these requirements. To meet this need, therefore, the Georgia Tech Engineering Experiment Station and the Georgia Agricultural Experiment Station have jointly designed, developed, constructed, and tested a new type of cattle-weighing scale.

Operating on the well-known principle that a liquid is practically incompressible and transmits pressure uniformly throughout any vessel in which it is confined, the new livestock-weighing scale, pictured in Figure 1, might be termed an "inverted hydraulic

**Supervisor, Engineering Design Section and Machine Shop, Georgia Tech Engineering Experiment Station.*

Figure 1. Weighing beef cattle at the Georgia Agricultural Experiment Station, using the new Georgia Tech hydraulic scales. Note the indicator housing located at the feet of the operator.

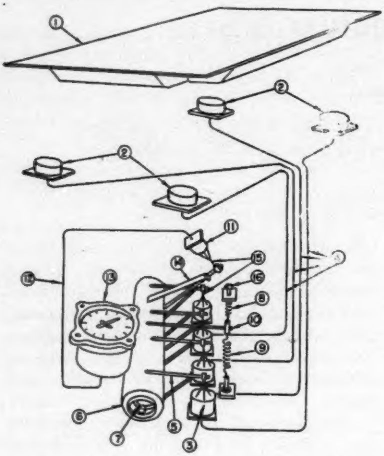


Figure 2.

jack," since the pressure created by a large weight upon the platform is utilized to move a small, sensitive pointer on the scale's dial. In fact, a hydraulic jack can be made to serve as a rather crude weighing device merely by attaching a pressure gauge to the oil-filled space below the ram. However, for accuracy and dependability, considerable refinements are necessary.

Although the principle of hydraulic weighing is not new, it is believed that the Georgia Tech scale combines accuracy with ruggedness and portability to a degree not achieved in any previous design. This is brought about by the use of a simple mechanical indicating system which eliminates the electrical or magnetic apparatus usually associated with scales of this type. Furthermore, the mechanism is entirely self-contained, so that the weighing platform and indicating system are permanently connected.

DESCRIPTION OF MECHANISM

The operating principle of this scale is illustrated in Figure 2. A rigid platform (1) is supported by four large pressure cells (2) which are fabricated from flexible metal bellows 5¾ inches in diameter and 2¼ inches high. Each large pressure cell is connected to a single smaller cell (3) of similar construction by means of a capillary tube (4), and each system formed thereby is completely filled with ethyl alcohol, after which it is hermetically sealed against leakage. Ethyl alcohol was chosen as the hydraulic fluid because of its low viscosity and low freezing point (−115° C.).

The smaller cells are grouped together within an instrument housing located at the side of the platform, and each cell is connected to the end of an arm (5) extending from a torque tube (6). This tube is supported at each end by means of two flexible metal strips (7) which permit a small amount of rotation about the tube's longitudinal axis. This rotation is restrained by means of two oppositely acting springs [(8) and (9)] which are attached at one end to a torque arm (10) and are anchored at their opposite ends to the instrument housing. One of these springs (8) is considerably weaker than the other (9) and is so arranged that its tension can be adjusted by means of a screw (16), thus providing a "zero calibration" for the mechanism.

Weight indication is obtained by means of a secondary hydraulic system consisting of a small pressure cell (11), similar to cells (3), which is connected by a capillary tube (12) to a sensitive pressure gauge (13), calibrated to read directly in pounds of weight upon the scale's platform. This system is completely filled with ethyl alcohol and is hermetically sealed in a manner similar to that used on the primary systems. The pressure cell (11) is attached to an arm (14) extending from the torque tube (6) in such a manner that any rotation of the torque tube will cause the cell to be compressed or extended. The effect of temperature changes upon the fluid contained within the secondary system is compensated for by another small bellows (not shown) which is also filled with ethyl alcohol and forms part of the mechanical link between the secondary cell (11) and its actuator arm (14).

USE OF FLEXURE JOINTS

An important feature of this new scale is the use of flexible steel push-pull rods (15) at the connection of the small pressure cells [(3) and (11)] to their respective torque

Continued on Page 23

PLANNING A SMALL RADIOISOTOPE PROGRAM

By GEORGE W. REID* *and* OSCAR M. BIZZELL**

The use of radioisotopes in research programs has spread to many fields since the end of the last world war. Consequently, in many phases of research it has now become necessary to maintain a supply of radioactive materials and to provide special laboratories for their use. The following article presents suggestions for the building of a laboratory suitable for the handling of radioactivity in the low microcurie range, as well as a brief summary of some of the considerations regarding nomenclature, cost, training, health physics, waste disposal, and materials of construction.

Many prospective users of radioisotopes are unacquainted with the problems that must be faced when setting up an isotope study program. Two of the major problems, for example, are an unfamiliarity with the nomenclature involved and an unfamiliarity with the prerequisites for the safe handling of radioactive materials. Although isotopes are valuable tools in research, one should not attempt to use them until thorough training in this field has been acquired.

Formerly Associate Professor of Sanitary Engineering, Georgia Institute of Technology; present address, the University of Oklahoma.

***Radiochemist, Isotopes Division, Atomic Energy Commission, Oak Ridge, Tennessee.*

A beginner needs considerable instruction and experience in order to cope successfully with the specific problems involving the use of radioisotopes; indeed, the lack of proper training has proved to be the largest single deterrent to wider isotope utilization. The purposes of this paper are: (1) to discuss some of the general prerequisites in planning a small radioisotope program, (2) to list several sources of reliable information on the safe handling and use of radioactive materials, (3) to describe the relative costs of the major items required in a radioisotope laboratory, (4) to outline the waste disposal problem involved, and (5) to give

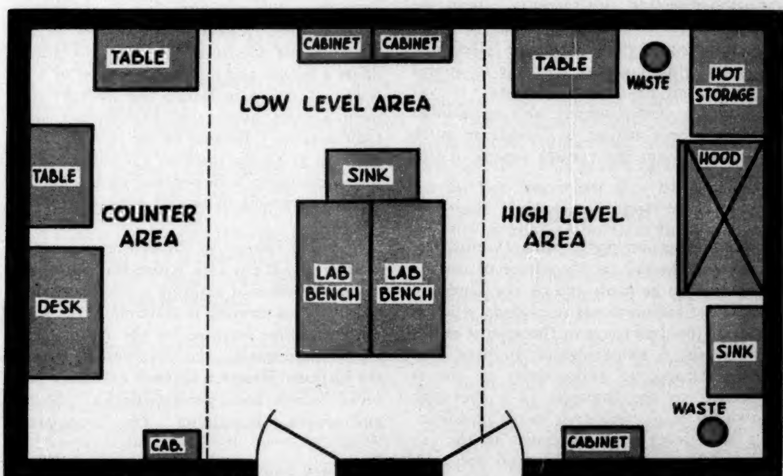


Figure 1. Suggested radiochemical laboratory layout, recognizing three separate areas of operation.

examples of some of the cooperative programs in this field.

Valuable information on radioisotope programs is obtainable from the Atomic Energy Commission's Isotopes Division, Oak Ridge, Tennessee, which is responsible for the allocation of all radioisotopes produced in and distributed through Commission facilities. The Advisory Field Service Branch of the Isotopes Division also offers consulting services to those planning a radioisotopes program. Expert analysis of a beginner's problems will often result in a considerable saving of time and money in the purchase of equipment and in the planning of the research program.

AVAILABLE LITERATURE

During the early planning stages of a radioisotope study program, elementary literature on isotope utilization should be acquired, particularly that regarding the nomenclature used in the field of radioactivity.[1] Unclassified atomic energy publications such as *Nuclear Science Abstracts* are available;[2] many of the references cited in the latter pertain to radioisotope applications. Other publications can be obtained from industrial laboratories that are manufacturing radiation-detecting instruments, preparing special isotope-labeled compounds, or offering consulting services on isotope techniques. Books on atomic energy continue to appear which present up-to-date treatment[3] of various phases of this subject, and many older texts have been revised to include as much as possible about the various aspects of this new field.

TRAINING

The degree of preliminary training required will depend on the nature of the investigation to be made and on the kind and quantity of radioisotopes employed; whether the study involves tracer or therapeutic radioactive levels. A knowledge of the basic concepts pertaining to radioactivity is just as important to the beginner as a thorough knowledge of physiology is to the physician, or a knowledge of mathematics to the engineer. These requirements should not serve to discourage persons planning a radioisotope laboratory; instead, they should be considered essential to performing satisfactory work.

To alleviate the shortage of trained personnel, the Atomic Energy Commission, in cooperation with various other organizations, has established several centers which offer instruction in radioisotope handling and health-safety procedures. Several of these training programs, with a brief description of each, are mentioned below. Even after basic training has been acquired by a designated individual, however, it may be still advisable for his organization to work in cooperation with a radioisotope laboratory actively engaged in specialized work.

Since training in handling techniques as well as training in the theoretical aspects are "musts," it may be well here to review briefly what training facilities exist and under what conditions they are available. Civilian training can be obtained at a number of places. The center which offers instruction most suited to the prospective radioisotope user is probably the Oak Ridge Institute of Nuclear Studies, located at Oak Ridge, Tennessee. This institute is a cooperative organization of 24 southern universities, representatives of the Atomic Energy Commission, and representatives of the Commission's industrial contractors in Oak Ridge. The Institute is the agency which knits these diverse groups into a new pattern of education. Under the direction of the Institute, its Division of Special Training offers a lecture and laboratory course of four weeks' duration in which the students perform a large number of experiments with radioisotopes.* Because of the reception that has been given the Institute's training course, the Commission is now planning to establish similar programs in several large metropolitan areas.

Also of interest to the prospective radioisotope user is the Oak Ridge National Laboratory's technical training course in health-safety. This training is available in the form of fellowships financed by the Atomic Energy Commission, and is administered by the National Research Council. Courses provided include basic physics, nuclear physics, and on-the-job training. The Brookhaven

*The course deals primarily with isotope techniques and costs $25. Further information can be secured from Dr. R. T. Overman, Director of Special Training Division, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee.

National Laboratory also has a program which is quite similar to the technical fellowship program at Oak Ridge. This program also is administered by the National Research Council.*

For the most part, regular university programs offer primarily postdoctorate work in medicine, biology, science, and engineering, but do not include short, intensive courses in radioactivity. However, some of the more progressive educational institutions are beginning to offer some basic instruction in isotope study techniques. The University of Colorado, Harvard University, North Carolina State University, the University of Rochester, Ohio State University, Columbia University, Washington University at St. Louis, the University of Michigan, and several Institutes of Technology such as Carnegie, California, and Massachusetts are examples. Further information can be obtained by writing to the individual institutions.

The United States Public Health Service planned to offer in Cincinnati, starting in September, 1950, a course to acquaint public health workers with radiological safety.**

Training programs sponsored wholly or in part by the armed services may also be of interest to public health workers. Although this training is not directly concerned with radioistope application, it will undoubtedly be of interest to those seeking information in the field of radiological defense. Such programs include: (1) a three-year curriculum developed jointly by the Radiological Safety Committee of the Army, Navy, Air Force, the Public Health Service, and other agencies,† (2) six week courses at Treasure Island, California; Biloxi, Mississippi; and Edgewood Arsenal, Maryland, for lower echelons, and (3) a one-week course at the Army Medical Center, Washington, D. C., for higher ranking officers.

*The duration of the course is one year and carries a stipend of $125-$200 per month. Complete information regarding these fellowships may be obtained by directing an inquiry to the National Research Council, Washington 25, D. C.

**Further information can be obtained from Dr. S. Kinsman, United States Public Health Service, Cincinnati, Ohio.

†Additional information on this three-year course may be had by addressing a request for DCO Circular No. 32-48 to the Federal Security Agency, Public Health Service, Washington 25, D. C.

PROGRAM COSTS

Probably one of the most important factors in planning the scope of a small radioisotope program is limitation of the budget that may be established. The extent of the funds available will determine whether it will be possible to build a completely new laboratory, incorporating a large number of desirable features, or whether the facilities to be used must be limited to alterations of an existing laboratory, which may necessitate putting up with a considerable number of inconveniences. If a budget must be drawn up during the planning stage of the program, it should be left as generous as possible.

Laboratory

The first major item of expense is the laboratory itself (hoods, furniture, etc.). Total requirements, which will vary with the types and amounts of isotopes to be used, will largely determine the cost. It is desirable to have the laboratory segregated into three parts (in the case of the use of only low-level, weak beta emitters, however, one room will suffice). These parts include: (1) a small area for "hot" storage and sample dilution, (2) an area in which the work with lower radioactive levels or with assay samples is conducted, and (3) an isolated area for counting.

A diagram of a laboratory for work at low millicurie levels of radioactivity incorporating these principles is shown in Figure 1. The air-flow pattern should be from areas of low radioactivity to areas of higher radioactivity; this means locating the hood in the hot area where it is logically needed the most. For work at tracer levels of radioactivity, a regular laboratory fume hood with a few modifications will suffice. All evaporations and other processes likely to spread radioactive contamination to the air should be performed therein.

A satisfactory hood for radioisotope work is shown in Figure 2. Adequate shielding from pure beta ray sources inside the fume hood can be achieved by the use of thick plastic (approximately one-half inch for hard beta ray emitters such as phosphorus 32). Because of their greater penetrating power, isotopes emitting gamma rays require, for personnel protection, the use of

more dense shielding (lead or iron), or that the operator be at a greater distance from the source.

Radioisotope laboratories should be properly marked for identification, and unauthorized personnel must be kept out, including janitors and special-service personnel who might be likely to enter after regular working hours. Such laboratories should be locked during those times when a responsible worker is not present.

Much has been written about the selection of structural materials for use in facilities for isotope study. One school of thought has it that the use of stainless steel is necessary for protective coverings in areas that are subject to radiochemical contamination. However, this concept is chiefly a carry-over from the large Commission laboratories which handle hundreds of curies. Information is now available on the results of a testing program[4] to determine the feasibility of using materials cheaper than stainless steel for laboratory construction. It was found that several commercially available coatings are practically as good as stainless steel for many applications, and that some can actually be decontaminated to a greater degree.

It is generally agreed, however, that stainless steel can be used advantageously in certain areas, two of these being the sink that is used for discarded radioactive wastes and the work surface of the fume hood. Cold-rolled stainless steel is practically as good as polished stainless steel from the standpoint of decontamination, and is usually cheaper and easier to fabricate.

The cost of outfitting such a laboratory as illustrated in Figure 1 (hoods, furniture, instruments, shielding, etc.), exclusive of the cost of the room, can be held to less than $5,000.

Instrumentation

The second major item of expense is the radiation-measuring equipment. This in-

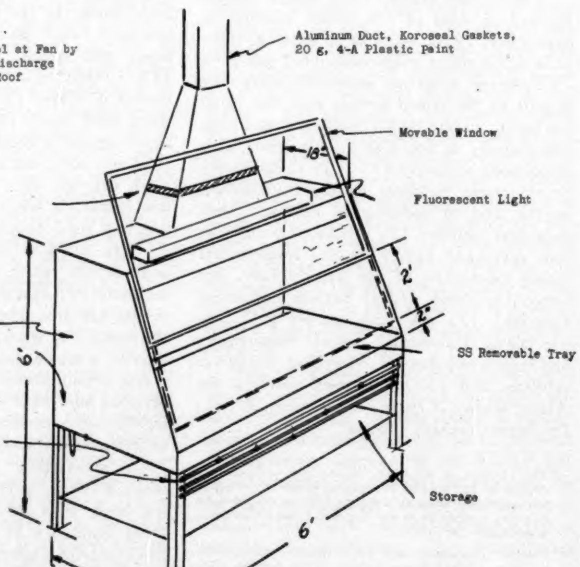


Figure 2. Suggested radioisotopes hood for tracer work.

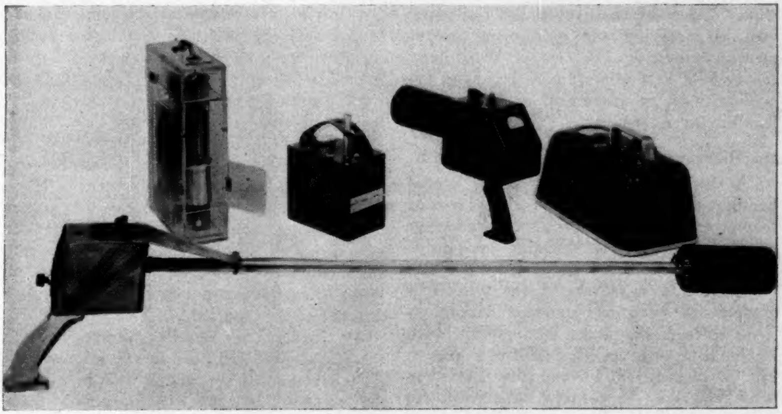


Figure 3. Radiation survey instruments.

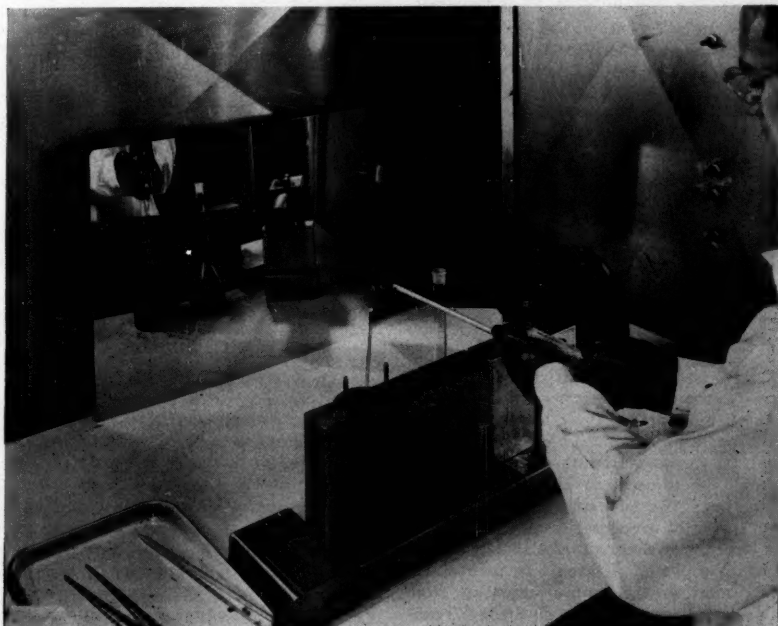


Figure 4. Simple equipment adequate for preparing a dilution of 10 millicuries of radioiodine (I^{131}).

cludes Geiger-Mueller tubes and scalers as well as surveying and monitoring instruments.[5] However, the cost of these items can be held to a minimum if first-hand experience with an instrument is obtained before buying it.

Miscellaneous Materials

A third item of expense is the special handling equipment, such as a remote-control pipetting device, special tongs, storage containers, and special shielding equipment. However, the cost of these items can also be held to a minimum if the worker is capable of adapting standard laboratory items to form the needed equipment. Much of this equipment, as illustrated in Figure 4, can be constructed without too much expense and will be entirely satisfactory for remote-control handling and processing of the radioisotopes.

The "expendables" (chemicals, glassware, etc.) in an isotope study laboratory are slightly more expensive than those found in other laboratories doing comparable work. Obviously, interchange of the equipment with nonradioactive laboratories cannot be allowed.

The radioisotopes themselves are usually not a big item of expense. The current price for radioactive iodine 131 is $1 per millicurie, while radioactive phosphorus 32 is $1.10 per millicurie, plus a moderate handling charge.[6] Many synthetic organic compounds labeled according to the desired position of the radioactive element within the molecule are commercially available.

HEALTH PHYSICS

The levels of radioactivity handled in most laboratories are lower by a factor of several million than those handled in Commission laboratories. Therefore, the scope of the necessary health-physics program should be adjusted to meet the particular situation.[7] If a laboratory is using comparatively small amounts of radioisotopes, it is unnecessary to set up an elaborate health-physics program. It should be pointed out that most of the isotope shipments from Oak Ridge are approximately 20 to 30 millicuries of short-lived isotopes (P^{32} and I^{131}), and most of the experimental work is performed in micro or low millicurie ranges.

Specific information on the minimum requirements that must be met before radioisotopes may be received can be obtained from the Isotopes Division.[6] The minimum requirement includes the possession and use of a calibrated survey meter for determining radiation field intensity and for locating contamination, plus laboratory facilities appropriate to the type and quantity of isotopes used. Personnel monitoring devices such as film badges, film rings, and pocket ionization chambers or dosimeters are recommended in most cases. The purchase of more elaborate equipment is left to the discretion of the laboratory.

In Figure 3 are shown a number of suitable ionization chamber survey instruments. The extended chamber on the instrument in the foreground is for the purpose of reading over barriers, through holes, and around corners without subjecting the operator to undue radiation.

Routine personnel monitoring is accomplished by using one or more of the detection devices shown in Figure 5. These are (from left to right) a standard type of film badge, a finger ring film badge (below), a dosimeter, and a pocket ionization chamber.

The health-physics records should include: (1) radioactive materials received and dispensed for various uses, (2) personnel exposure, (3) laboratory surveys, and (4) waste disposal records. The first two are recommended in connection with the use of *all* radioisotopes; the last two should also be kept when using the long-lived radioisotopes.

WASTE DISPOSAL

The disposal of radioactive wastes presents a problem that is unique. Since radioactivity cannot be neutralized, nor can the rate of decay be altered, the disposal of radioactive wastes must be carefully controlled either by their dilution to a nonhazardous concentration or by storage until their activity has decayed to a negligible value. The problem of waste disposal is being given considerable attention at this time by the National Committee on Radiation Protection, and some recommendations have already been made.[8] These include (1) dilution and dispersion, in which special consideration is given to the nature of the

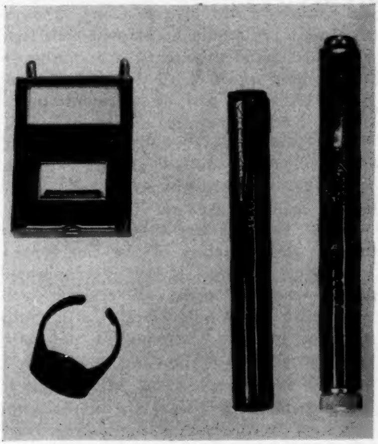


Figure 5. Personnel monitoring devices.

diluting medium, and (2) concentration and confinement. Means for accomplishing the concentration include evaporation, precipitation, ion exchange, and incineration.

The United States Public Health Department and the Atomic Energy Commission are cooperating actively in the field of radioactive waste disposal. The following lines of research now under way are typical of the investigations being conducted.

Effects of Radioactivity on Sewage Systems

The Department of Sanitary Engineering of New York University has a research contract for studying the effects of radioisotopes on sewage treatment processes to determine the concentration of radioactive wastes that can be discharged safely into sewage systems. One of the features of this study is the availability of a sewage treatment plant with a capacity of 100,000 gallons per day which can be run on a pilot-plant basis. The Sanitary Engineering Department of the Johns Hopkins University is studying the effect of concentration of radioactivity by bacterial slimes, and associated problems. The Oak Ridge National Laboratory is working on a similar project with the cooperation of the United States Public Health Service and the Sanitary Engineering Department of the Tennessee Valley Authority.

Biological Concentration Processes

The United States Public Health Service and the University of California are cooperating with the Atomic Energy Commission at Los Alamos on studies dealing with the concentration of radioactivity by the use of activated sludge.

Filter and Dust Collection Methods

The Harvard School of Public Health is studying the applications of supersonic chambers and the use of sudden cooling of supersaturated air to remove dust particles. The Arthur D. Little Company, Carbide and Carbon Chemicals Corporation, and the Chemical Corps of the United States Army are cooperating in the design and production of special filters for removing small airborne particles.

The diversity of approaches and the range of special abilities that are being applied would seem to insure in time a satisfactory solution to many of the puzzling questions in the field of waste disposal. Studies dealing with additional problems more closely related to the fields of public health, such as cancer, heart disease, control of epidemics (especially by water-borne bacteria, and airborne pollution, etc.), await primarily the availability of personnel trained in the use of radioisotopes.

* * * * *

Adequate preliminary training is essential if one is to avoid pitfalls encountered in laboratory design, purchase of equipment, drawing of false conclusions from experiments, etc. All aspects of a planned program should be investigated as thoroughly as possible before any definite action is taken. Budgetary considerations can possibly be met by careful program planning, careful design of the laboratory, and judicious selection of equipment. Sources of information and assistance are available by means of which the starting of a small isotope study program can be more readily accomplished.

BIBLIOGRAPHY

1. *A Glossary of Scientific Terms Relating to Atomic Energy*, United States Government Printing Office, Washington, D. C.
2. Prices vary, but price lists can be obtained from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

3. a. Lapp, R. E. and Andrews, H. L., *Nuclear Radiation Physics*, Prentice Hall, Inc., New York, 1949.
   b. Cork, J. M., *Radioactivity and Nuclear Physics*, D. Van Nostrand Co., Inc., New York, 1947.
   c. Pollard, E. C. and Davidson, W. L., Jr., *Applied Nuclear Physics*, John Wiley and Sons, Inc., New York, 1946.
   d. Kamen, M. D., *Radioactive Tracers in Biology*, Academic Press, Inc., New York, 1950.
   e. Schweitzer, G. K. and Whitney, I. B., *Radioactive Tracer Techniques*, D. Van Nostrand Co., Inc., New York, 1949.
   f. *Safe Handling of Radioactive Isotopes*, Handbook 42, National Bureau of Standards, Washington 25, D. C., 1949.
4. Tompkins, P. C., Bizzell, O. M., and Watson, C. D., "Working Surfaces for Radiochemical Laboratories," *Industrial and Engineering Chemistry 42*, 1469-81 (1950).
5. *Radiation Instrument Catalog*, Office of Technical Services, Department of Commerce, Washington, D. C.
6. *Isotopes*, catalog and price lists, Isotopes Division, U. S. Atomic Energy Commission, Oak Ridge, Tennessee.
7. Morgan, K. Z., "The Responsibilities of Health Physics," *Scientific Monthly 63*, Aug., 93-100, (1946).
8. *Interim Recommendations for the Disposal of Radioactive Wastes by Off-Commission Users*, Isotopes Division Circular B-6, Isotopes Division, Oak Ridge, Tennessee, 1948.

Presented before the 25th Annual Meeting of the Texas Public Health Association.

GEORGIA TECH LIBRARY

Continued from Page 6

(bound volumes, 1884 to date, plus the weekly card index), *Industrial Arts Index* (1913-), and such supplementary indexes as the *Bibliography of Agriculture* (1942-), *Bibliography of Scientific and Industrial Reports* (1946-), *Biological Abstracts* (1926-), *Biometrika* (1901-), *Ceramic Abstracts* (1922-), *Gas Abstracts* (1945-), *Iron and Steel Institute Journal* (1869-), *Journal of the Society of Glass Technology* (1917-), *Metallurgical Abstracts* (1934-), *Natural and Synthetic Fibers* (1944-), *Petroleum Research Abstracts* (1944-), *Plastics Index* (1944-), *Refrigeration Abstracts* (1946-), *Resins, Rubbers, Plastics, Abstract Service* (1942-), *Science Abstracts* (1898-), *Textile Research* (1931-), Worden's *Chemical Patent Index*, etc.

To supplement these indexes the library has a complete file of the *Official Gazette* of the United States Patent Office, and is endeavoring to acquire a complete collection of United States patents; as a beginning it has acquired copies of all those issued since April, 1946. As part of its patent collection it has also acquired *British Abridged Patent Specifications* (1855-). There is no real patent library anywhere in the South, and one is sorely needed. To house and to maintain a patent collection is very expensive, yet members of the Georgia Tech faculty, staff members of the Engineering Experiment Station, industrial representatives, and the Librarian all feel that such an expense would be justified. Outside help must be obtained, however, if the early issues of the United States patents are to be acquired.

In regard to the library's actual holdings of chemical and chemical engineering journals, a complete list would be far too long to include here. Typical accessions are files of all the American Chemical Society's journals, the British Chemical Society's journal and abstracts, the French *Bulletin de la Societe Chimique, Berichte der Deutschen Chemischen Gessellschaft, Journal of the Society of Chemical Industry, Journal of the American Institute of Chemical Engineers, Journal of the Electrochemical Society, Annales de Chimie, Annales de Physique, Annalen der Chemie, Gazetta Chimica Italiana, Journal fur Praktische Chemie, Chemiker-Zeitung, Monatshefte fur Chemie, Recueil des Travaux Chimiques des Pays-Bas, Bulletin de la Societe Chimique de Belgique, Svensk-Kemisk Tidskrift, Chemische Weekblad, Helvetica Chimica Acta,* plus many complete files of specialized journals in the various fields of chemistry.

This list does not even begin to include the numerous trade journals and technical society periodicals in fields of related endeavor—pulp and paper, textiles, petroleum, ceramics, naval stores, etc. Moreover, it does not include the many reference and text books, handbooks, and catalogues which have been written in all of these fields. When it is further considered that the library has also attempted to acquire the literature of the sciences of physics and

Continued on Page 20

DIGESTS OF GRADUATE THESES

CHEMICAL ENGINEERING

1949-1950

The following digests represent summaries of theses submitted during 1949-1950 in partial fulfillment of the requirements for the degrees of Doctor of Philosophy and Master of Science in Chemical Engineering. This is the second in a series of features designed to present data on the graduate theses submitted last year to the various schools of the Georgia Institute of Technology.

William L. Carter. *Characteristics of a Packed Distillation Column: Correlation of H.T.U. With Operating Variables for Rectification of Carbon Tetrachloride-Toluene Mixtures. * Faculty advisor: Dr. J. W. Mason.**

A number of investigators have expressed doubt of the usefulness of the Colburn equation for $(H.T.U.)_{OV}$ in correlating distillation data. This investigation was conducted to study the effect of operating variables such as vapor velocity, vapor-liquid ratio, and over-all system composition on the performance of a packed distillation column, and to correlate the resulting data in terms of $(H.T.U.)_{OV}$.

Data are presented for the distillation of carbon tetrachloride-toluene mixtures in a column packed with a nickel "protruded" packing. The column was operated adiabatically, and was designed so that vapor-liquid ratios existing in either the rectifying or stripping sections of a continuous fractionating column could be studied.

Correlations of the data in terms of $(H.T.U.)_{OV}$ with a m_aV/L, with V/L, and with liquid velocity are presented in graphical form for the various vapor velocities and over-all system compositions that were examined. It was found that a minimum value of $(H.T.U.)_{OV}$ approximately equal to 0.5 foot was obtained at values of m_aV/L in the range 0.7-1.0 and at values of V/L in the range 0.8-1.1. On either side of these ranges, $(H.T.U.)_{OV}$ increased with further change in either m_aV/L or V/L; the rate of increase was more pronounced at the lower vapor velocities. In the correlations of $(H.T.U.)_{OV}$ with V/L and with liquid velocity, it was observed that over-all system composition did not appear to be a factor affecting these correlations; however, in correlations with m_aV/L the effect of composition was quite apparent. Whereas straight lines are predicted by the Colburn equation for plots of $(H.T.U.)_{OV}$ versus m_aV/L, the results of this investigation indicate that this correlation gives a curved line which goes through a minimum value of $(H.T.U.)_{OV}$.

*Ph.D. thesis. All subsequent theses were for the M.S. degree.

Bolling Gay Brawley. *An Investigation of Capillary Spreading Power of Emulsions.* Faculty advisor: Dr. J. M. DallaValle.

The penetration of porous materials by fluids is especially important in the manufacture of textiles, papers, and leathers, fields in which emulsions are frequently employed. Some study has been made of the penetration of pure liquids into capillary spaces, but little consideration has been given to the penetration of emulsions.

The experimental work involved the independent measurement of surface tension, viscosity, and time of horizontal capillary flow under varying conditions of temperature, emulsion concentration, capillary radius, and capillary length.

The capillary spreading power is defined as the time (t) necessary for an emulsion to penetrate a fixed distance (x) under the influence of capillary forces alone, and was found to be proportional to the ratio of the viscosity (μ) to the surface tension (σ) when the capillary radius (r) was constant and the angle of contact (Θ) was zero, as shown in the equation:

$$t = K \frac{x^{1.575}}{r \cos \theta} \frac{\mu}{\sigma} = K^1 \frac{\mu}{\sigma}$$

The capillary spreading power or penetration time of an emulsion in a horizontal

capillary can be used as a relative measure of the penetration in a porous material under the influence of capillary forces alone, if the angle of contact of the emulsion with the solid is known or small in value.

William Stough Hoover, Jr., *The Effect of Certain Additives Upon the Physical Properties of Portland Cement.* Faculty advisor: Dr. William M. Newton.

The object of this investigation was first to conduct a literature study on and evaluation of the additives and treatments used for oil-well cements, and then to conduct an experimental program in search of some substance that would act more effectively as a set-retarding agent when added to ordinary, gray, Type I Portland cement, an agent which would not lessen (and would perhaps even increase) the strength of the cement after 24 hours.

To slurries of gray, Type I Portland cement composed of 40 per cent water (by weight of dry cement), varying amounts of $Na_4P_2O_7 \cdot 10H_2O$ and red quebracho extract were added in concentrations ranging from 0.051 to 0.205 per cent by weight of dry cement. The $Na_4P_2O_7 \cdot 10H_2O$ was found to increase the setting rate and decrease the compressive strength of the set cement, while quebracho retarded the setting by 0.449 to 1.076 hours and increased the compressive strength by an average amount of 28.8 per cent.

The results of the consistency tests using quebracho also compare favorably with data from tests on commercially retarded cements. No record has been found in the literature of any set-retardant which also increases the strength of set cement.

Albert P. Little, *Solvent Extraction of Georgia Pine Needles.* Faculty advisor: Dr. William M. Newton.

A maximum content of about nine per cent by weight of Georgia pine needles was recovered by solvent extraction. Curves of extract in per cent of pine-needle weight versus both time and extraction cycles are presented. It was found that there was a two-fold variation in the per cent extracted by the various solvents: acetone, petroleum ether, benzene, isopropyl alcohol, and methyl ethyl ketone, but the rate of extraction based on the per cent of total extract was approximately the same.

Fractional vacuum distillation of the extracts produced small fractions ranging from thin colorless oils to thick amber masses. Curves of boiling points and refractive indices for these samples are presented as a function of cumulative per cent overhead.

Richard Lee Meek, *Rate Studies in Molecular Distillation.* Faculty advisor: Dr. William M. Newton.

An investigation was made to study the effects of surface temperature, system pressure, and mechanical stirring on the rate of distillation in a pot-type molecular still. Results obtained indicate that the rate of distillation increases and the efficiency of distillation decreases with increase in temperature. The "critical pressure" (highest pressure under which satisfactory molecular distillation will take place) for this particular still was found by both measurement and calculation to be 0.03 micron. Mechanical stirring had no appreciable effect on the rate. The rates of distillation obtained in this study are in substantial agreement with the few rates recorded by previous investigators, although different types of stills and different materials were employed in these earlier studies.

John Morris, *The Effect of Oxidation on the 2,3-Positions on the Decarboxylation of Certain Polyanhydrouronic Acids.* Faculty advisor: Dr. Nathan Sugarman.

This study was directed toward determining whether the Lefevre and Tollens method of uronic acid analysis could be applied to certain polyanhydrouronic acids which had been oxidized at the 2- and 3-positions of the anhydrouronic acid units. To determine this, it was necessary to study the behavior of carboxyl groups on the 2- and 3-carbon atoms under the conditions of the analysis, and to discover whether oxidation at the 2- and 3-positions interfered with decarboxylation of the carboxyl group on the 6-carbon atom.

Under the conditions of the Lefevre and Tollens method of uronic acid analysis, decarboxylation of the carboxyl groups on the 6-carbon atom of galacturonic acid, polyanhydrogalacturonic acid, glucuronic acid, and certain other uronic acids proceeds exponentially and is quantitatively complete in eight hours. In the case of polyanhydromannuronic acid and polyanhydroglucuronic acid,

evolution is not complete in 15 hours. Decarboxylation of the carboxyl groups of the 2- and 3-carbon atoms of oxidized cellulose proceeds linearly at a slow rate. Under the conditions of the analysis, these groups decarboxylate at the rate of approximately one third of one per cent per hour.

Attempts to prepare a compound oxidized on the 2-, 3-, and 6-carbon atoms were unsuccessful. Other considerations indicate that such a substance would decarboxylate linearly at a slow rate.

COATINGS RESEARCH

Continued from Page 4

gation on primers was sponsored jointly by the Southern Paint and Varnish Production Club and the Georgia Tech Engineering Experiment Station, with the Southern Pine Association furnishing all lumber for test fences and panels. The studies conducted required accurate formulation of a number of exterior paint primers containing systematic variations in pigment and vehicle. The paints were then applied uniformly on pine panels, and, after drying, the panels were placed on outdoor test fences for weathering exposure. The exposed panels were examined at intervals for a period of four years; at the end of that time the accumulated data were studied and evaluated. The results of this investigation* have made a significant contribution of information which has led to the development of improved formulations for the painting of southern yellow pine.

During the past year, the original paint laboratory has been expanded into a special laboratory equipped for the study of decorative and protective coatings. Facilities are available for formulation and testing of nearly all types of finishes, so that both fundamental and applied research problems related to the coatings field can be undertaken.

*Leonard Wilkins and Paul Weber, "Physical Studies of Primers in Two-Coat Paint Systems Applied to Southern Yellow Pine," *Official Digest (Federation of Paint and Varnish Production Clubs)*, No. 265, 88-121 (1947); Georgia Tech Engineering Experiment Station Reprint No. 21.

Figure 2. Baker-Perkins mixer.

This coatings laboratory is now engaged in a continuation of the earlier program on paint primers, under the same sponsorship. The main part of the present work, "Physical Studies of Paint Systems Applied to Southern Yellow Pine," consists of the preparation and exposure of a large number of exterior primer-top coat systems. Several primers from the previous studies have been selected for exposure, along with other primers and top coats which represent suggestions from many leading paint technologists. Obviously, no attempt is being made to study systematic composition variations throughout all of these formulations; however, such modifications of some of the basic formulations are included in the main program. Essentially, the main program is a comparative study of what are considered to be the best exterior primer-top coat systems available today for application to southern yellow pine. It is believed that this investigation will provide valuable data for further improvement of paint durability on this wood.

As a supplement to the main program, additional studies of a "pioneering" nature will be included. Many of the newer types of plastic and resin coatings will be investigated. Methods of wood pretreatment to improve paintability will be considered. Recently developed synthetic vehicles will be studied. Many paint technologists feel that studies along these lines—development of new materials and techniques—will be necessary before the ultimate solution to the problem of painting southern yellow pine can be completely achieved.

FACILITIES

The equipment and facilities used for the previous studies of paint primers provided an excellent nucleus around which the new coatings laboratory has been developed. Perhaps the most valuable inheritance is the Paint Exposure Station used in the earlier investigation. This station, which is also being used in the present program, is located on an elevated table of land overlooking the Marietta Highway, about ten miles north of the Georgia Tech campus. About 2,880 square feet of test panels may be exposed on the existing test fences, and space could be provided for even more panels if necessary. About one half of the test fences are vertical south exposures; the other one half are 45° south exposures. Since most house paint is applied to vertical surfaces, vertical south exposures are most frequently used for exterior paint testing in order to duplicate practical conditions. 45° South exposures are useful for accelerated weathering tests and for testing such materials as porch and deck enamels and automotive finishes, materials that must withstand rather severe weathering conditions. Should the need arise, all of the panels could be easily converted to provide either type of exposure. The space available at the Paint Exposure Station is adequate for all anticipated needs of the coatings laboratory.

The new coatings laboratory at the Engineering Experiment Station contains a one-gallon capacity paste mixer; a small, table-model three-roll mill; a Kaydel moisture gauge; a Stormer viscosimeter; and other incidental laboratory accessories. Supplementing these items, a number of new pieces of equipment have been acquired. A Day three-roll mill with water-cooled 5" x 12" rolls has been purchased for the laboratory. This mill, shown on the cover of this issue, is used for the grinding of most paints and enamels. For heavy mixing of pastes and plastic materials, a Baker-Perkins mixer was obtained. A laboratory-size rubber mill was purchased from the National Rubber Mill Company for mixing and grinding of rubber compounds and similar materials. A forced-draft, controlled-temperature oven has been obtained for the processing of baked finishes.

In addition to the major items of equipment mentioned, testing equipment such as the Hegman fineness-of-grind gauge and a weight-per-gallon cup manufactured by the Gardner Laboratories has been purchased. Other pieces of laboratory equipment and apparatus are being acquired as needs arise.

The coatings laboratory is housed in a large, well constructed frame building which has a concrete foundation and floor. Large windows on three sides supply excellent light and ventilation to all parts of the laboratory. Equipment and supplies are spaced and arranged for maximum safety and convenience of workers.

The Georgia Tech Engineering Experiment Station is well aware of the importance of research and development in the coatings field. The large textile and paper industries in this region manufacture materials on which many types of coatings can be used, both within their plants and in plants built specially for this purpose. The continuing growth of heavy manufacturing industries producing hardware, tools, machinery, implements, etc., necessitates development of industrial finishes, particularly metal finishes, to meet various requirements for protection, durability, and beauty.

A coatings research laboratory should fulfill the dual functions of developing and evaluating new and improved coatings and of conducting research on basic physical and chemical problems whose solution must precede future development. Because this second phase of research is not immediately profitable to its industrial sponsors, it often suffers neglect. The Georgia Tech Engineering Experiment Station, through its new coatings laboratory, seeks to provide both these essential research services to southern industry.

GEORGIA TECH LIBRARY

Continued from Page 16

mathematics and such engineering fields as aeronautical engineering, civil engineering, mechanical engineering, electrical engineering, industrial engineering, textile engineering, etc., it can be seen that a sizable goal has been set.

The library receives by current subscription 17 Russian journals; the file of none of these is complete, however. This library, like many others throughout the world, is attempting to build a worthwhile file of Russian periodicals.

The Georgia Tech Library participates in the Farmington Plan for the acquisition of foreign publications. It is the depository for all foreign books in the field of textile industries, and it plans to make its textile collection exhaustive. Complete files or long runs of the following journals may be found in the library: *American Dyestuff Reporter, Farben-Zeitung, Journal of the Society of Dyers and Colorists, Melliand's Textilberichte, Textile Colorist, Textile Mercury, Textile World, Journal of the Textile Institute, Dyer, Rayon Textile Monthly,* and *Textile Technology Digest.*

As regards the chemical and chemical engineering collections, these are housed in the main library buildings, with working collections in both the School of Chemistry and the School of Chemical Engineering. Both of these working collections contain sets of *Chemical Abstracts* in addition to the various reference works which are most pertinent to their respective fields. Moreover, many chemical reference works are contained in the working collection assigned to the Georgia Tech Engineering Experiment Station.

The library's entire collection, of course, is rendered easily accessible through its card catalogues. Only a small number of study spaces can be provided in the main library building, however, although some additional study spaces are available in connection with the above-mentioned working collections.

Space does not permit discussion of the library's departmental libraries which have been established in the Schools of Architecture and Aeronautical Engineering, and of the working collections which have been assigned to the Schools of Ceramic and Textile Engineering. Reference to these has been made elsewhere.[3]

TECHNICAL INFORMATION SERVICE

The Technical Information Division of the Georgia Tech Engineering Experiment Station is not a part of the library structure, although closely associated with it. This group was organized by the Engineering Experiment Station in 1945 to serve a multiplicity of purposes.[6] Within the Station, this division provides the background information needed to conduct various research problems by preparing, upon request, complete literature and patent searches and surveys. It also manages patent matters concerned with the Station's research program; edits and handles the publication of all Station bulletins, circulars, reprints, and special reports; serves as a "quality control" group for Station reports to sponsors of research programs; and has charge of technical public relation activities, including exhibits and news releases.

In addition, the Technical Information Division provides a variety of services for any who may need them. This division is housed in a wing of the Engineering Experiment Station's main Research Building; at present, its staff contains three technically trained persons and an equal number of stenographers. Additional part-time and temporary personnel is employed as needed.

INFORMATION SERVICE PROGRAM

According to the statutes of the Georgia Institute of Technology, the State Engineering Experiment Station is designated as the Institute's agent for the execution of contracts with outside organizations for research and developmental programs, whether they be conducted in the Station's buildings or in those of the various schools and departments. Authorized by the Georgia Legislature in 1919 and established on a permanent basis in 1936, the Station is the engineering and industrial research agency of the University System of Georgia. It serves to coordinate and to advance the research activities of the Institute through an integrated program of fundamental and applied research and development for the purpose of contributing to the general welfare of Georgia and the nation. It is organized to aid directly in the development and integration of industrial and agricultural activities and the better utilization of resources in the South, through its investigations and technological studies.

In addition to those fundamental and applied projects which it sponsors itself,

the Georgia Tech Engineering Experiment Station conducts numerous nonprofit research programs for private industries, industrial groups, government agencies, the Armed Forces, and individuals. These projects deal with problems in almost all of the fields of science and engineering. For example, the Station at present is engaged in several electronic and electrical engineering programs, numerous aeronautical engineering studies, research in the field of hydraulics, the design of mechanical equipment for agricultural and textile purposes, and in such chemical and chemical engineering programs as those dealing with food freezing, superconductivity of metals and alloys, fine particle studies, peanut oil extraction, and water and sewage analysis.

Obviously, background information was required before research could be inaugurated in many of these programs, and it was for this purpose that the Station created its Technical Information Division in 1945. Since then, this division has prepared numerous background literature searches and surveys, several of which have later been published in order that they might be available to others.[1 2 4 5 7]

Basing its activities on the readily accessible collection of the Georgia Tech Library, the Technical Information Division has concentrated its efforts on the development of a staff of engineering and scientific subject specialists, trained to use their backgrounds to utilize library accessions as tools. Staff members are thus more qualified and better able to work directly with those needing informational assistance.

In those fields of specialization in which its staff has no experience, the Technical Information Division has rendered service to research workers through provision of work forms, instruction in their use, suggestions as to sources of information, and in the preparation of the final informational reports. In no case, of course, has the division attempted to separate the scientist from contact with the literature; instead, it has striven to make this contact easier, more accurate, and less time consuming.

Through use of the Georgia Tech Library and, when needed, other libraries of this region and elsewhere, the Technical Information Division of the Georgia Tech Engineering Experiment Station has also conducted a number of informational and patent searches and surveys directly for outside agencies, on a nonprofit basis through Georgia Tech Research Institute contracts. Most of these programs were on a confidential basis, so that no details can be given here.

FUTURE PLANS

The Georgia Tech Library and the Experiment Station's Technical Information Division are by no means content with the present level of their activities, since it is clearly evident that far greater service potentialities exist.

In the case of the Institute's library, the long needed new building will probably be authorized soon, so that protection from fire may be given to a collection which would be irreplaceable if destroyed, and also so that full use may be made of the collection of books and journals. This new building is to be functional in plan, completely air-conditioned, with seating space for 900 and book shelves for 450,000 volumes. There will be study carrells for graduate students and work space for research engineers and others from industry.

While even further facilities will be needed if the library's service potentialities can be fully realized, it will be possible, when this building is completed, to offer industry a well rounded program of services in addition to those made available by the Experiment Station's Technical Information Division. Details have not, as yet, been worked out, but the Georgia Tech Library intends to provide working space for representatives of local industries who need access to its files, to augment its photoprint and translation services, etc. In addition, the library will continue to endeavor to build up collections in special fields of importance to this region and to Engineering Experiment Station research.

The Technical Information Division of the Georgia Tech Engineering Experiment Station is also planning to increase the scope of its activities. At present, for example, it hopes to prepare additional current information analyses similar to its recently inaugurated "Monthly Summary of Industrial Developments (Related to Petroleum

Processing)," and it hopes to issue several abstract bulletins.

The division also intends to make its services more generally available by augmenting its staff as needed. It recognizes a real opportunity to be of assistance, an opportunity which has been recognized elsewhere by the John Crerar Library and the Detroit Public Library. Obviously, the scope of its activities will grow with the expansion of the facilities of the Georgia Tech Library.

A university library has a unique opportunity to make its services useful for several purposes, each of which is of considerable importance. Service to graduate students, faculty members, and research scientists in the performance of research and development activities is not the least of these. While it cannot be pretended that the Georgia Tech program described in this paper is unique in every respect or on a scale unapproached elsewhere, it is hoped that this description will have served a useful purpose as a concrete example of what one institution is doing.

BIBLIOGRAPHY

(1) Anderson, Betty and Weil, B. H., *First Supplement to the Literature Search on the Preservation of Foods by Freezing*, Georgia Institute of Technology, State Engineering Experiment Station Special Report No. 25, 1948. 264 pages. $3.

(2) Bolen, Marjorie and Weil, B. H., *Literature Search on Dry Cell Technology*, Georgia Institute of Technology, State Engineering Experiment Station Special Report No. 27, 1948. 700 pages. $5.

(3) Crosland, Dorothy, "Report from the Library," *The Research Engineer*, May, 1946, pp. 22, 23; September, 1946, pp. 20-22; November, 1946, pp. 22-24; March, 1947, pp. 15, 16, 20; May, 1947, pp. 15-17; September, 1947, pp. 15, 16; November, 1947, pp. 15-17; January, 1948, pp. 13-15; September, 1948, pp. 13, 14, 22; September, 1949, pp. 17, 18, 23; November, 1949, pp. 13-15; March, 1950, pp. 13, 14.

(4) Weil, B. H. and Sterne, Frances, *Literature Search on the Preservation of Foods by Freezing*, Georgia Institute of Technology, State Engineering Experiment Station Special Report No. 23, 1946. 405 pages. $4.

(5) Weil, B. H., *et al., Literature Search on the Solvent Extraction of Oleaginous Materials*, Georgia Institute of Technology, State Engineering Experiment Station Special Report No. 26, 1948. 185 pages. $4.

(6) Weil, B. H., "Technical Information Service at Georgia Tech," *Manufacturers Record 117*, No. 8, 36, 37, 56 (1948); Georgia Institute of Technology, State Engineering Experiment Station Circular No. 23.

(7) Weil, B. H., *et al., Bibliography on Water and Sewage Analysis*, Georgia Institute of Technology, State Engineering Experiment Station Special Report No. 28, 1948. 215 pages. $4.

HYDRAULIC SCALE

Continued from Page 8

arms, instead of rotating joints or bearings. Likewise, the ends of springs (8) and (9) are rigidly connected by silver brazing instead of by means of conventional hooks. These, in combination with the flexure strips (7) previously described, provide a mechanism which is completely free of any sliding or rolling friction, and, since all flexure connections are designed to operate well within the elastic range of the materials, any bending resistance becomes a part of the internal spring constant of the system. Furthermore, since the amount of angular displacement of each such joint is very small, the effect on the reading of the pressure gauge (13) varies almost directly in proportion to the weight on the scale platform, thus eliminating the need for any nonlinear compensator within the indicating mechanism.

OPERATION

Operation of the scale proceeds as follows, as may be noted by reference to Figure 2: when an object is placed upon the scale, its weight will be distributed among the large pressure cells in a manner depending upon its location on the platform. However, the sum of the weights carried by each cell will always be exactly equal to the weight of the object, regardless of its position on the platform. Since the large cells, which are identical in size and construction, are connected to the smaller cells, which are likewise identical, it is evident that the same internal hydraulic pressure will be produced in each smaller cell that is produced in its larger companion.

Thus, the sum of the forces exerted by the smaller cells will remain constant for a given weight on the platform, regardless of the position of the weight on the platform, and, since the arms (5) extending from the torque tube are of equal length, the rotating moment exerted upon the torque tube will likewise remain constant. As previously described, the rotation is restricted to a small angle by the extension of spring (9), so that there is no need for nonlinear compensation.

For purposes of explanation, in the foregoing description the ideal situation has been assumed, i.e., that all of the pressure cells of each size are identical. Actually, this is not necessary, since the only requirement of this design is that equal weights upon each large cell will create equal rotating moments upon the torque tube. In order to compensate for variations in the size or spring constant of the pressure cells, it is only necessary to vary the length of the various torque arms (5) accordingly. In practice, the characteristics of several cells, even of similar size and construction, will vary slightly, so that an adjustment is provided at the point of attachment of each flexure joint to the torque arm. This permits the joint to be set at the proper location along the arm when the scale is calibrated.

Referring again to Figure 2, it may be seen that rotation of the torque tube due to extension of the smaller cells (3) will produce a compression of cell (11) in the secondary hydraulic system. This in turn produces a small pressure within the system which is registered by the sensitive pressure gauge in terms of pounds weight upon the scale platform.

When weighing wild or unruly cattle, it is necessary to provide some sort of barrier to retain the animal on the platform until a reading can be taken. In such cases, the portable enclosure pictured in Figure 1 is used. This enclosure may be quickly disassembled for ease of transportation. A gate is provided at each end, and the sides are supported by inserting the lower ends of the tubular steel uprights into sockets in a separate steel frame which encircles the platform. The small portable ramps are used to encourage the animals to step onto the platform.

No extensive preparation of the ground is required in order to set up the scale. If the land is not level, a few shovelfuls of earth may be removed in order to provide a reasonably solid footing. It is not necessary to level the platform accurately, since a few degrees slope in any direction will not materially affect the accuracy of the scale. However, in the experimental model a small cross-test level was attached to the instrument housing as an aid in setting up the scale.

OTHER USES

Although this scale is primarily designed for weighing cattle, it is also particularly suitable for rapid weighing, in the field, of carts or wheelbarrows used in any mixing process (such as the making of concrete); or as a vehicle scale for highway use since it may be easily transported to any convenient location. In the latter case, a vehicle having several axles can be weighed by the use of a number of scales positioned according to the vehicle's wheelbase. The same procedure is applicable for weighing aircraft, using a separate unit under each landing wheel.

* * * * *

This scale, the high-speed seed-planting machinery developed here at the Station and previously described in these columns,* and peanut processing equipment now under study are all parts of a program designed to benefit Georgia agriculture through the cooperation of the Georgia Tech Engineering Experiment Station and the Georgia Agriculture Experiment Station. Only by proper mechanization can agriculture keep abreast of this modern world.

RESEARCH FACILITIES

Continued from Page 2

able to afford adequate facilities of their own has long been recognized, and was the basis for the foundation of engineering experiment stations in many states. At Georgia Tech, for example, as the various issues of THE RESEARCH ENGINEER have attested, the Engineering Experiment Station renders services in many fields in which it has developed facilities and has acquired staff experts. In turn, the Station has realized full well that its unique services cannot be efficiently rendered unless it possesses adequate equipment and laboratory space. Optimum quantities of both have not yet been achieved, but the recent completion and occupation of the new wing of the Station's Hinman Research Building will certainly enable the Station to conduct its operations more effectively and to offer its services on a wider basis.

*Hall, R. A., "Development of Seed-Planting Machinery," *The Research Engineer 1947-1948*, No. 1, 13-14, 22-24, (May, 1947).